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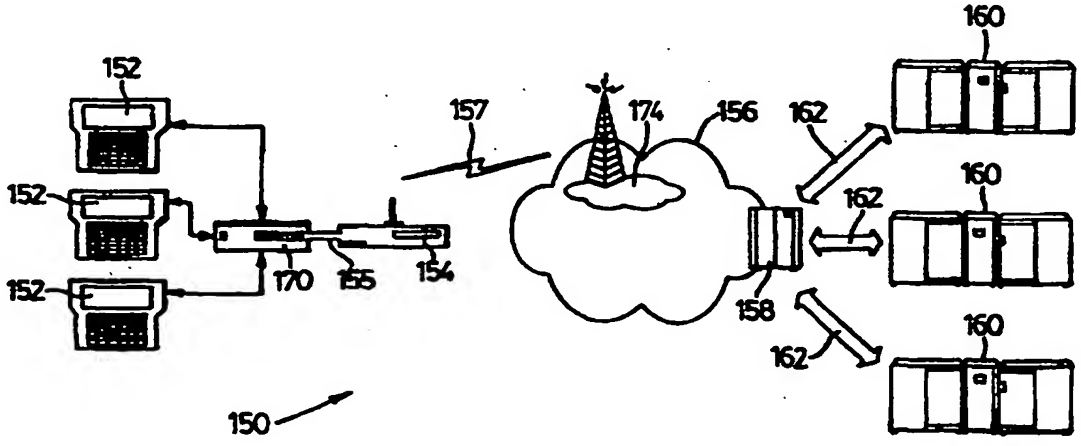

(57) Abstract

A wireless wide area communication system (150) comprises at least one electronic fund transfer/point-of-sale (EFT/POS) device (152) generating an EFT/POS financial transaction data message in response to a financial transaction request. A wireless communications converter (154) in communication with the at least one EFT/POS device receives the EFT/POS financial transaction data message. The wireless communications converter converts the EFT/POS financial transaction data message into a form suitable for transmission over a radio frequency wireless wide area network (wireless WAN) (156). The wireless WAN is connected to at least one financial institution (160) by way of a gateway (158) and a land line connection (162) and conveys the EFT/POS financial transaction data message received from the wireless communications converter to the at least one financial institution.

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WIRELESS ELECTRONIC FUNDS TRANSFER/POINT-OF-SALE PACKET ASSEMBLER-DISASSEMBLER

TECHNICAL FIELD

The present invention relates to radio frequency (RF) communications systems and in particular to a wireless wide area communications system and to a wireless communications converter for use therein to allow electronic debit and/or credit transactions and/or other relevant electronic funds transfer (EFT)/point-of-sale (POS) transactions to be carried out over a wireless communications network.

BACKGROUND ART

Computer communications systems typically include a collection of computing resources called hosts, a collection of users, some of which are associated with the hosts, and a communications subnet that connects the hosts and users. The communications subnet has basic components, namely a communications link and switching elements commonly referred to as switching nodes along the communications link. Many different computer communications systems of the above type exist as a result of the selected physical medium used for the communications link, the selected communications subnet topology and the switching technique implemented.

In some applications, the computer communications systems include point-of-sale (POS) devices at the user locations to allow financial transaction data to be communicated over the communications link between the users and the financial institutions. For security and communications protocol reasons, the communications subnet has made use of leased, private, dedicated or public dial-up telephone lines to establish a communications link between the point-of-sale devices and the financial institutions over which the financial transaction data is transmitted. Alternative means to establish a communications link between the point-of-sale devices and the financial institutions are however desired.

It is therefore an object of the present invention to provide a novel wireless wide area communications system and a wireless communications converter to allow financial transaction data to be transmitted over a wireless radio frequency (RF) communications link.

DISCLOSURE OF THE INVENTION

The present invention provides a wireless wide area communications system over which financial transaction data is communicated via a radio frequency (RF) communications link to obviate the need for leased or dial-up telephone lines or other land lines interconnecting user locations and a financial institution. The wireless wide area communications system includes at least one EFT/POS device into which financial transaction data is entered. The at least one EFT/POS device conveys the financial transaction data to a wireless communications converter (wireless PAD) via a hardwire communications link either directly or through a local area network (LAN) controller. The wireless PAD converts the financial transaction data into a form which allows the financial transaction data to be transmitted over a RF communications link. Once transmitted over the RF communications link, the financial transaction data is conveyed to the financial institution where the financial transaction data is processed.

According to one aspect of the present invention there is provided a wireless wide area communications system comprising:

at least one electronic fund transfer/point-of-sale (EFT/POS) device generating an EFT/POS financial transaction data message in response to a financial transaction request;

a wireless communications converter in communication with said at least one EFT/POS device for receiving said EFT/POS financial transaction data message; and

a radio frequency wireless wide area network (wireless WAN) in wireless communication with said wireless communications converter and in communication with at least one financial institution by way of a gateway and a land line connection, said wireless WAN conveying said EFT/POS financial transaction data message received from said wireless communications converter to said financial institution wherein said wireless communications converter converts said EFT/POS financial transaction data message into a form suitable for transmission over said radio

frequency wireless WAN and said gateway and land line connection to said at least one financial institution.

Preferably, the EFT/POS financial transaction data message includes a point-of-sale end-to-end (POS ETE) header. The wireless communications converter adds a wireless WAN transport header to the EFT/POS financial transaction data message prior to transmitting the EFT/POS financial transaction data message to the wireless WAN. The wireless WAN transport header establishes control over land line connection oriented protocols. In a preferred form, the wireless WAN transport header includes an exception code carrying communications and result information concerning the state of the gateway and land line connection. The communications and result information includes gateway and land line connection and action data such as land line status information.

In one form, the wireless communications converter is integral with the EFT/POS device. Alternatively, the wireless wide area communications system includes a local area network interposed between the at least one EFT/POS device and the wireless communications converter.

In one embodiment, the gateway and land line connection includes at least one direct X.25 data link extending to the at least one financial institution. In another embodiment, the gateway and land line connection includes an X.25 data link extending to a wide area network with the wide area network being connected to the at least one financial institution by way of an X.25 data link.

Preferably, the wireless communications converter includes a modem to receive the EFT/POS financial transaction data message, a processor in communication with the modem for converting the EFT/POS financial transaction data message and a radio packet modem to transmit the converted EFT/POS financial transaction data message to the wireless WAN.

According to another aspect of the present invention there is provided a wireless communications converter comprising:

a modem to receive an electronic fund transfer/point-of-sale (EFT/POS) financial transaction data message;

a processor in communication with said modem for converting said EFT/POS financial transaction data message into a form suitable for wireless transmission over a radio frequency wireless wide area network (wireless WAN); and

a radio packet modem for transmitting said converted EFT/POS financial transaction data message to said wireless WAN.

The present invention provides advantages in that financial transaction data can be communicated between EFT/POS devices and a financial institution without requiring the need for a leased or dial-up telephone line or other land line interconnecting the EFT/POS devices and the financial institutions. The financial transaction data is transmitted between the EFT/POS devices and the financial institution over a RF communications link. In the case where the wireless PAD is integral with the EFT/POS device, since the EFT/POS device is fully transportable, financial transactions can be carried out over the RF communications link at virtually any location.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention will now be described more fully with reference to the accompanying drawings in which:

Figure 1a is a schematic of a prior art wide area communications system;

Figure 1b is a schematic of a prior art wide area communications system implementing a hardwired DATAPAC® communications subnet;

Figure 2a is a schematic of a wireless wide area communications system in accordance with the present invention including a radio frequency communications subnet implementing a Motorola NCL communications protocol, and a wireless WAN transport protocol and using a direct Gateway to host connection;

Figure 2b is a schematic of a wireless wide area communications system in accordance with the present invention including a radio frequency communications subnet implementing a Motorola NCL communications protocol, and using a backbone X.25 packet data network as the Gateway to host connection via a

wide area network;

Figure 3 is a block diagram of a wireless communications converter (PAD) used in the communications systems of Figures 2a and 2b;

Figure 4 is a diagram showing the format of financial transaction data transmitted over the wireless wide area communications system of Figure 2a;

Figure 5a is a block diagram showing the communications protocols and protocol stacks used in the wireless wide area communications system of Figure 2a;

Figure 5b is a block diagram showing the communications protocols and protocol stacks used in the wireless WAN communications system for automated teller machines (ATMs)/automated banking machines (ABMs) EFT/POS devices;

Figure 6 is a diagram showing the format of a wireless WAN transport protocol header used during transmission of financial transaction data over the wireless wide area communications systems of Figures 2a and 2b; and

Figure 7 is a schematic of an alternative embodiment of a wireless wide area communications system in accordance with the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

For ease of understanding, a brief description of a prior art wide area communications system will firstly be described with reference to Figures 1a and 1b. As can be seen in Figure 1a, wide area communications system 10 includes a plurality of point-of-sale (POS) devices generally indicated to by reference numeral 12 at user locations, a financial institution 14 and a wide area network (WAN) 16 interconnecting the POS devices 12 and the financial institution 14. The communications system 10 allows electronic debit and/or credit financial transaction data to be transmitted between the POS devices 12 and the financial institution 14. This allows financial transactions to be carried out remotely without requiring an individual to visit the financial institution to authorize the financial transaction. In the particular example illustrated, the POS devices 12 and the financial institution 14 are hardwired to the WAN 16. Data communications between the POS devices 12 and

the financial institution 14 over WAN 16 is on an X.25 - based data package communications subnet such as for example, DATAPAC® in Canada, TELENET® or TYMNET® in the United States or TRANSPAC® in France. This type of communications subnet makes use of a leased telephone line over which the financial transaction data is communicated.

Figure 1b shows the prior art wide area communications system 10 using a DATAPAC® service as the communications subnet. In this particular embodiment, a local area network (LAN) controller 20 is connected to the POS devices 12 and controls financial transaction data exchange between the POS devices 12 and the WAN 16. The LAN controller 20 is also connected to a terminal pad 22 of the DATAPAC® service 24. The DATAPAC® service 24 uses leased telephone lines to convey financial transaction data between the POS devices 12 and a plurality of financial institutions 14. A public switch 26 is connected to the WAN 16 and controls data exchange between the WAN 16 and the financial institutions 14 via DATAPAC® 3000 services 28. As should be appreciated, during communications, the POS devices 12 are hardwired to the financial institutions 14 by way of the WAN 16.

Referring now to Figure 2a, an embodiment of a wireless wide area communications system 150 in accordance with the present invention is shown. As can be seen, the wireless wide area communications system includes a plurality of EFT/POS devices 152 connected to a local area network (LAN) controller 170. LAN controller 170 is also connected to the wireless PAD 54 via a DATAPAC® 3201 service 155 and controls data exchange between the EFT/POS devices 152 and the wireless PAD 154. The wireless PAD 154 implements a protocol suitable for wireless transmission of data and transmits financial transaction data generated by the EFT/POS devices 152 to the wireless WAN 156 via an RF communications link 157. The wireless WAN 156 includes base stations 174 between which the financial transaction data is transmitted. In the particular embodiment shown, the wireless PAD 154 implements a Motorola NCL protocol which is used by the wireless WAN 156. The wireless WAN 156 is also connected to a Gateway 158 which itself is connected to financial institutions 160 by way of direct X.25 data links 162.

Alternatively as shown in Figure 2b, the communications link between the Gateway 158 and the financial institutions 160 can be in the form of an X.25 packet data network (backbone X.25 network) including a wide area network 124, a public switch 126 and X.25 data links 162, instead of direct X.25 data links.

Figure 3 best illustrates the wireless PAD 54. As can be seen, wireless PAD includes a Bell 202T or dial-up modem 180 connected to a leased telephone line DATAPAC® service 155 extending to the LAN controller 170. The modem 180 is also connected to a processor 182. The processor 182 is connected to a radio module and radio packet modem (RPM) 184 which communicates with a Motorola® radio frequency (RF) module 186 via an RS232 serial connection 188. The RF module 186 establishes a radio frequency link with the wireless WAN 156 via the communications link 157.

The transmission of financial transaction data across the wireless wide area communications system 150, similar to communications over most computer communications systems, is based on a hierarchical model that comprises layers. Each layer offers a specified service that it provides to the adjacent layers. The rules for performing functions at a given layer are called protocols and the interactions between adjacent layers are called interfaces.

Referring now to Figure 5a, the layers used to transmit financial transaction data across the wide area communications system 150 are shown. As can be seen, at least four (4) types of layers are used by the wireless wide area communications system 150. These layers include a physical layer, a data link layer, a network layer and an applications layer. The physical layer is concerned with transmitting data over a communications link. The data link layer is concerned with transforming the transmission facility into one that appears free of transmission errors. The network layer is concerned with controlling the operation of the communications subnet. The applications layer includes information designed to ensure that the financial transaction data is received by the EFT/POS devices 152 or financial institutions 160 in a correct and understandable form.

The operation of the wireless wide area communications systems 150

will now be described with particular reference to Figures 2a and 4. In operation, financial transaction data 100 is entered into an EFT/POS device 52, 152 when a user wishes to complete a point-of-sale financial transaction. Once the financial transaction data has been entered, the EFT/POS device 152 creates a financial transaction data message to be sent to a financial institution. The EFT/POS device 152 in turn conveys the data message to the LAN controller 170. The LAN controller 70 in turn establishes a communications link with the wireless PAD 154 via the DATAPAC 3201 service 155 and transmits the data message to the wireless PAD 154.

The wireless PAD 154 receives the data message communicated across the leased telephone line 110 via the modem 180. The modem 180 passes the information to the processor 182. The processor 182 extracts the message from the transmitted information and then adds a point-of-sale end-to-end (POS ETE) header and a wireless WAN transport header to the message. The POS ETE network layer allows the processor 82 to communicate the information to the radio module and RPM 84 which uses a Native Control Language (NCL) protocol 122.

Figure 6 illustrates the form of the wireless WAN transport header. The wireless WAN transport header establishes wireless PAD functionality and control over land line connection oriented protocols such as for example X.25, TCP/IP etc. As can be seen, the wireless WAN transport header includes a one byte Exception code. Exception code is designed to carry communications and result information concerning the Gateway to host land line state, such as connector information and action (i.e. call request, X.25 call confirmation etc.) as well as to modify and report the status of X.25 specific Q and D bits.

The radio module and RPM 84 in turn conveys the information with the POS ETE and wireless WAN transport headers to the RF module 86 via the RS232 connection 88. The RF module 86 in turn adds a NCL data header as well as an RD LAP data link layer to the information before transmitting the information to the wireless WAN 56 via the radio communications link 57.

The wireless WAN 56 conveys the information between base stations

174 in the above form until it reaches the Gateway 158. At the interface between the wireless WAN 156 and the Gateway 158, the wireless WAN 156 replaces the NCL header, wireless WAN transport header and RD LAP data link layer with a standard X.25 header to the information before conveying the information to the appropriate financial institution 160 via the X.25 data link 162.

The appropriate financial institution 160 in turn receives the information via the X.25 data link 162 and extracts the message to isolate the original financial transaction message entered into the EFT/POS device 152. This allows the financial institution 160 to process the financial transaction data and authorize the financial transaction data if appropriate. When the financial institution 160 transmits financial transaction response data to one of the EFT/POS devices 152, the transmitted data is processed in the reverse manner to that described above. Figure 4 illustrates the data format of information transmitted over the wide area communications system 150 between an EFT/POS device 152 and a financial institution 160.

Figure 5b illustrates an alternative embodiment of the communications protocol and protocol stacks used in the wireless wide area communicators system 150 for ATM/ABM EFT/POS devices. As can be seen, the protocol is similar to that shown in Figure 5a except that the DP3201 and Bell 202T layer are replaced with Polled SDLC/HDLC and physical layers.

Referring now to Figure 7, an alternative embodiment of a wireless wide area communications system in accordance with the present invention is shown and is generally indicated to by reference numeral 350. As can be seen, wireless wide area communications system 350 includes a plurality of EFT/POS devices 352 connected directly to a wireless communications converter (PAD) 354 via a DATAPAC® 3201 service 355. Wireless PAD 354 is operable to establish a radio frequency (RF) communications link 357 with a wireless WAN 356. Wireless WAN 356 is connected to a Gateway 358 which is hardwired to financial institutions 360 via a X.25 data link 362. The wireless wide area communications system 350 allows financial transaction data to be transmitted between the EFT/POS devices 52 and the

financial institutions 60 in the same manner described previously so that financial transactions can be carried out remotely without requiring an individual to visit the financial institutions.

During operation, when an EFT/POS device 352 initiates a point-of-sale transaction, the EFT/POS device goes off-hook. The wireless PAD 354 provides a dial tone to the EFT/POS device 352. The EFT/POS device 352 in turn recognizes the dial tone and initiates a dialling sequence. The wireless PAD 354 recognizes the dialling sequence and in turn establishes a modem connection with the appropriate financial institution 360 over the wireless WAN 356. The wireless PAD 354 collects the financial transaction data from the EFT/POS device 352 and then transmits the financial transaction data to the financial institution 360 over the wireless WAN connection in the form described previously. The financial transaction response generated by the financial institution 360 is received by the wireless PAD 354 and is conveyed to the EFT POS device 312.

Although particular embodiments of a wireless wide area communications system have been desired which communicates financial transaction data over an RF communications link via a wireless WAN implementing a Motorola NCL protocol, those of skill in the art will appreciate that the wireless PAD may be used with other communications systems. Examples of such systems are mobile data networks, cellular radio networks such as Mobitex PCS, CDPD, and GSM as well as advanced (2-way) paging service networks.

Although the wireless PAD is shown separate from the EFT/POS devices, it should be appreciated by those of skill in the art that the wireless PAD may be integral with the EFT/POS devices. In this case, the EFT/POS devices are fully transportable allowing financial transactions to be carried out over the wireless WAN at virtually any location.

Those of skill in the art will also appreciate that other variations and modifications may be made to the present invention without departing from the spirit and scope thereof as defined by the appended claims.

What is Claimed is:

1. A wireless wide area communications system comprising:

at least one electronic fund transfer/point-of-sale (EFT/POS) device generating an EFT/POS financial transaction data message in response to a financial transaction request;

a wireless communications converter in communication with said at least one EFT/POS device for receiving said EFT/POS financial transaction data message;

a radio frequency wireless wide area network (wireless WAN) in wireless communication with said wireless communications converter and in communication with at least one financial institution by way of a gateway and a land line connection, said wireless WAN conveying said EFT/POS financial transaction data message received from said wireless communications converter to said financial institution wherein said wireless communications converter converts said EFT/POS financial transaction data message into a form suitable for transmission over said radio frequency wireless WAN and said gateway and land line connection to said at least one financial institution.

2. A wireless wide area communications system as defined in claim 1 wherein said EFT/POS financial transaction data message includes a point-of-sale end-to-end (POS ETE) header, said wireless communications converter adding a wireless WAN transport header to said EFT/POS financial transaction data message prior to transmitting said EFT/POS financial transaction data message to said wireless WAN.

3. A wireless wide area communications system as defined in claim 2 wherein said wireless WAN transport header establishes control over land line connection oriented protocols.

4. A wireless wide area communications system as defined in claim 3 wherein said wireless WAN transport header includes an exception code carrying communications and result information concerning the state of said gateway and land line connection.

5. A wireless wide area communications system as defined in claim 4 wherein said communications and result information includes gateway and land line connection and action data.

6. A wireless wide area communications system as defined in claim 5 wherein said connection data includes land line status information.

7. A wireless wide area communications system as defined in claim 4 wherein said wireless communications converter is integral with said at least one EFT/POS device.

8. A wireless wide area communications system as defined in claim 4 further including a local area network interposed between said at least one EFT/POS device and said wireless communications converter.

9. A wireless wide area communications system as defined in claim 8 wherein said local area network includes a LAN controller in communication with said wireless communications converter by way of a telephone line connection.

10. A wireless wide area communications system as defined in claim 4 wherein said gateway and land line connection includes at least one direct X.25 data link extending to said at least one financial institution.

11. A wireless wide area communications system as defined in claim 10 wherein said gateway and land line connection includes an X.25 data link extending to

a wide area network, said wide area network being connected to said at least one financial institution by way of an X.25 data link.

12. A wireless wide area communications system as defined in claim 4 wherein said wireless communications converter includes a modem to receive said EFT/POS financial transaction data message, a processor in communication with said modem for converting said EFT/POS financial transaction data message, and a radio packet modem to transmit said converted EFT/POS financial transaction data message to said wireless WAN.

13. A wireless communications converter comprising:

a modem to receive an electronic fund transfer/point-of-sale (EFT/POS) financial transaction data message;

a processor in communication with said modem for converting said EFT/POS financial transaction data message into a form suitable for wireless transmission over a radio frequency wireless wide area network (wireless WAN); and

a radio packet modem for transmitting said converted EFT/POS financial transaction data message to said wireless WAN.

14. A wireless communications converter as defined in claim 13 wherein said EFT/POS financial transaction data message includes a point-of-sale end-to-end (POS ETE) header, said processor adding a wireless WAN transport header to said EFT/POS financial transaction data message prior to transmitting said EFT/POS financial transaction data message to said wireless WAN.

15. A wireless communications converter as defined in claim 14 wherein said wireless WAN transport header establishes control over land line connection oriented protocols.

16. A wireless communications converter as defined in claim 15 wherein said wireless WAN transport header includes an exception code carrying communications and result information concerning the state of gateway and land line connections to said wireless WAN.

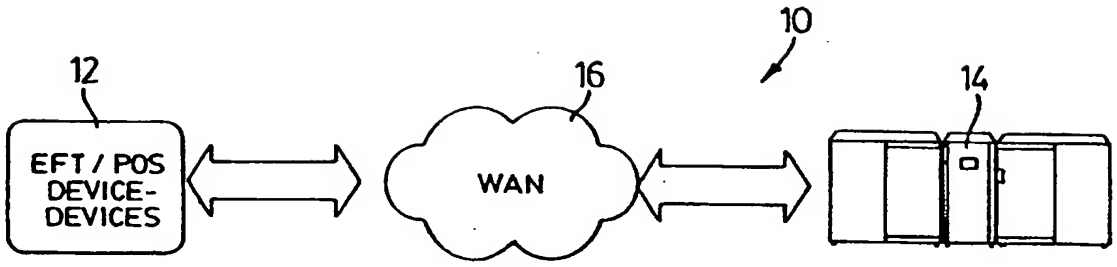


FIG. 1a
(PRIOR ART)

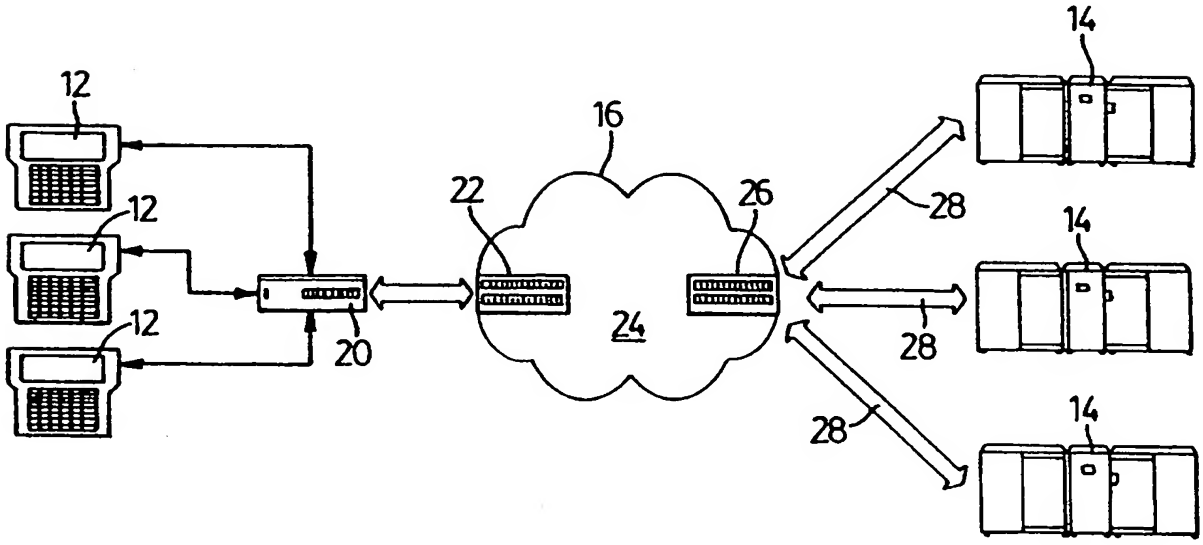
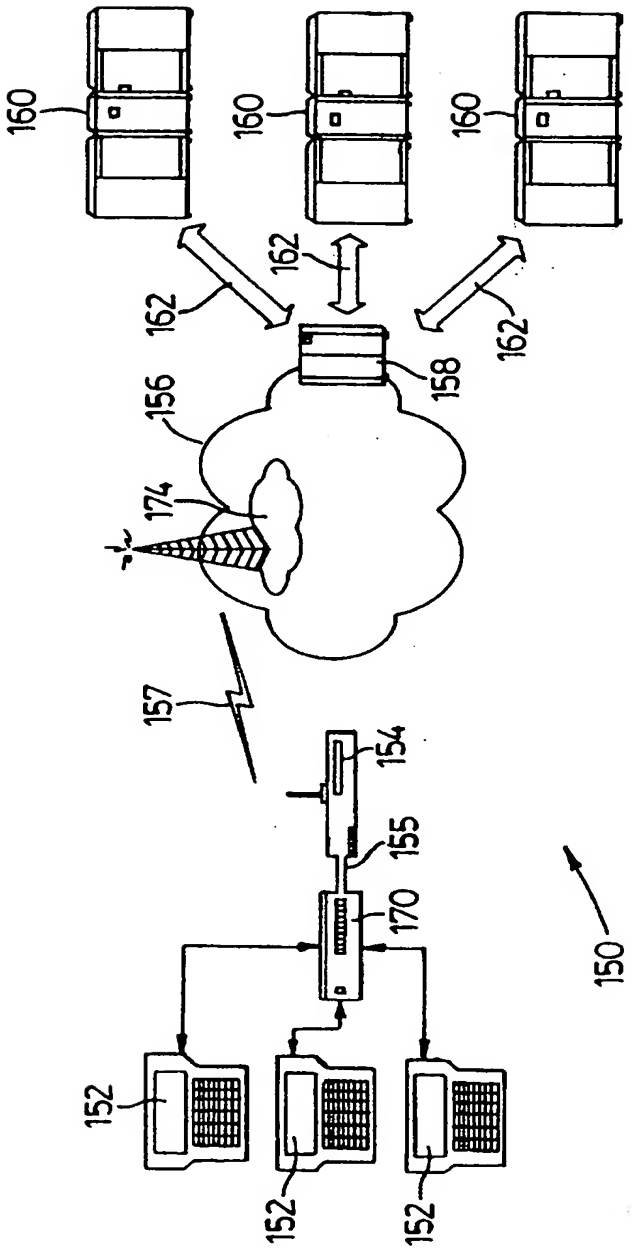


FIG. 1b
(PRIOR ART)


160
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174
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170
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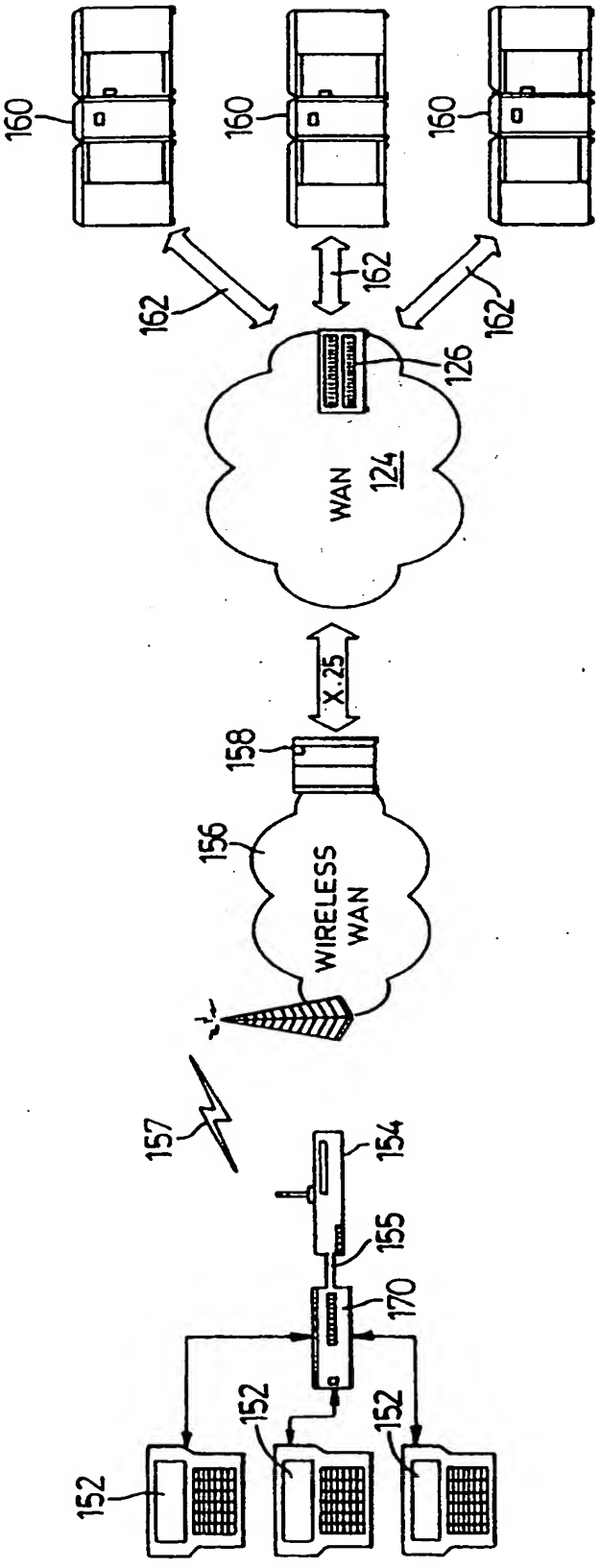
152
152

FIG. 2a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160
160
162
162
162
126
WAN
124
X.25
158
156
WIRELESS
WAN
157
154
155
170
152
152
152
150

FIG. 2b

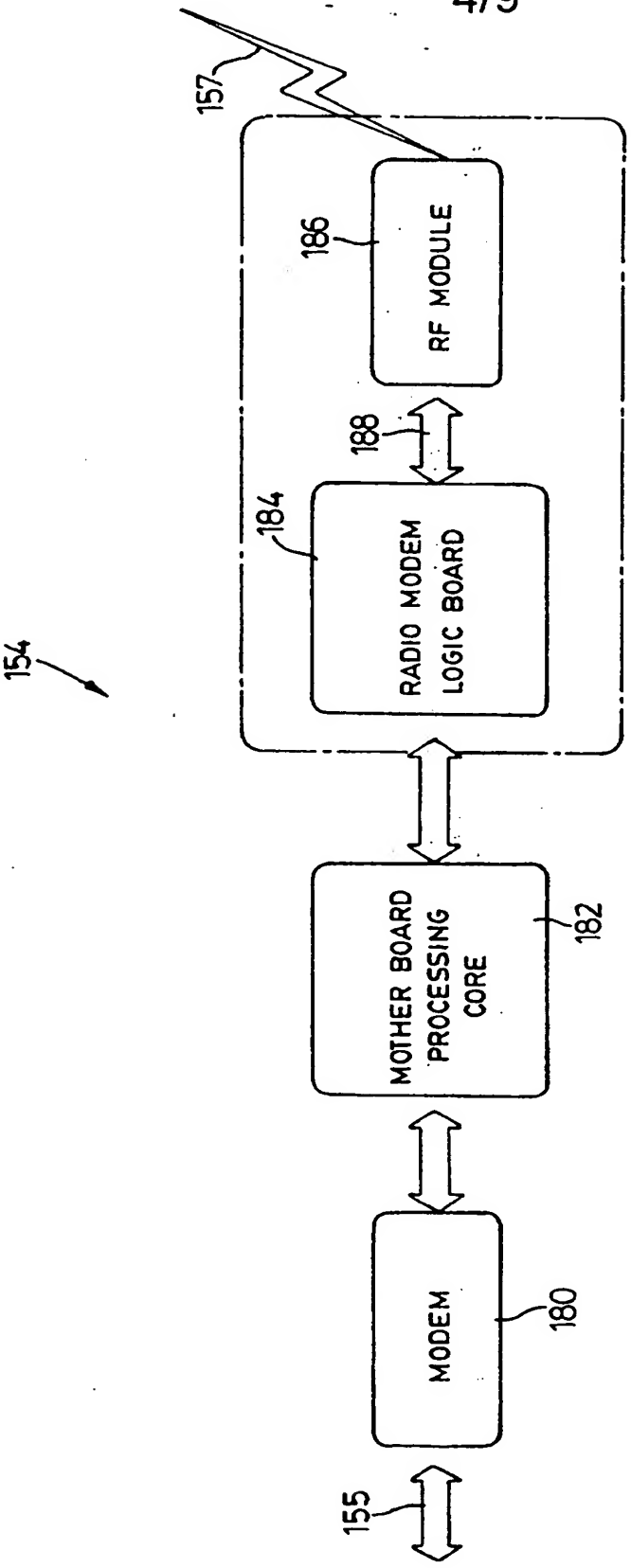

157
186
RF MODULE
188
184
RADIO MODEM LOGIC BOARD
154
MOTHER BOARD PROCESSING CORE
182
MODEM
180
155

FIG. 3

MESSAGE FORMATS THROUGHOUT THE COMMUNICATION CHAIN
IMPLEMENTATION: MOTOROLA DATA TAC 4000
NETWORK OPERATOR: BELL MOBILITY - ARDIS

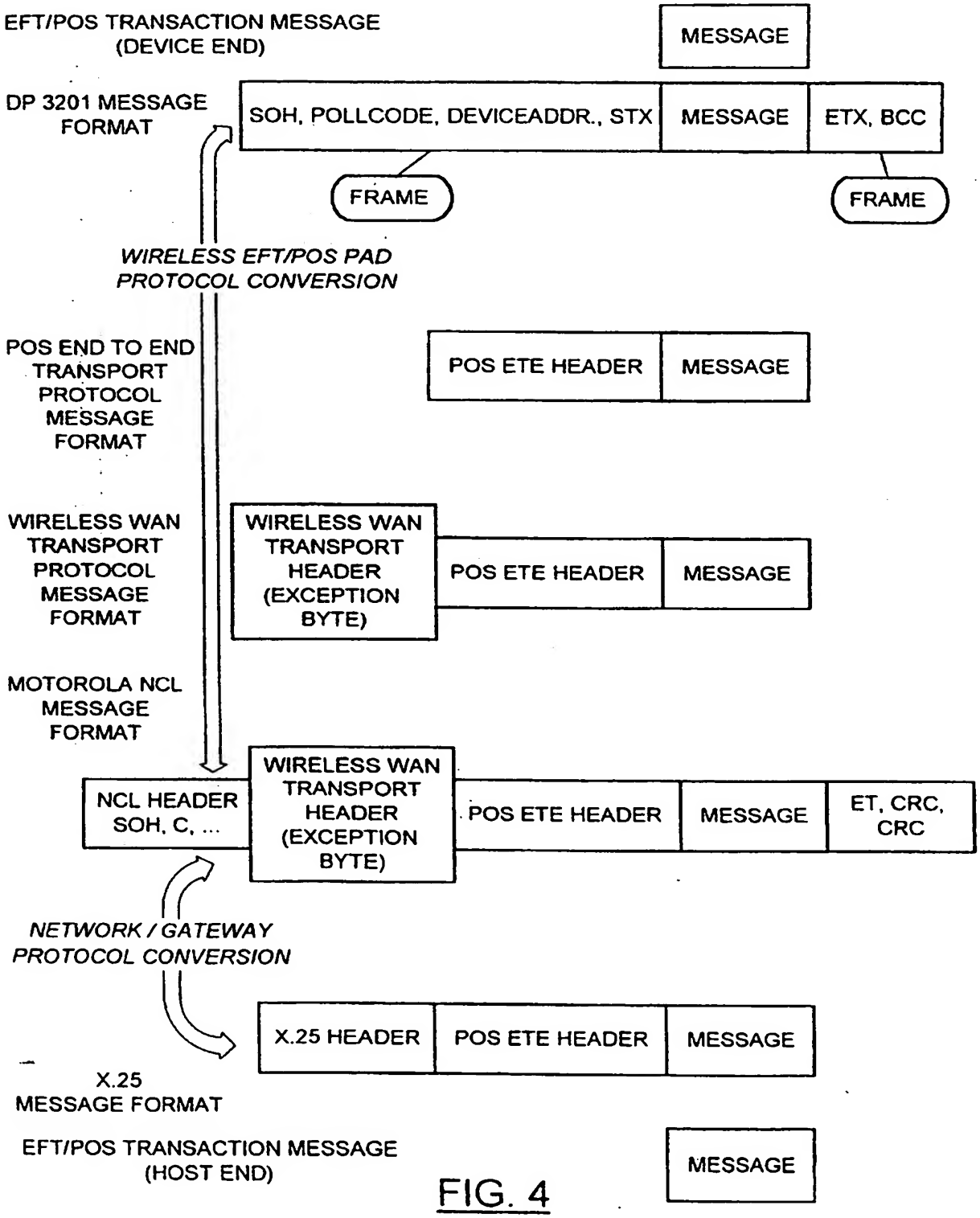


FIG. 4

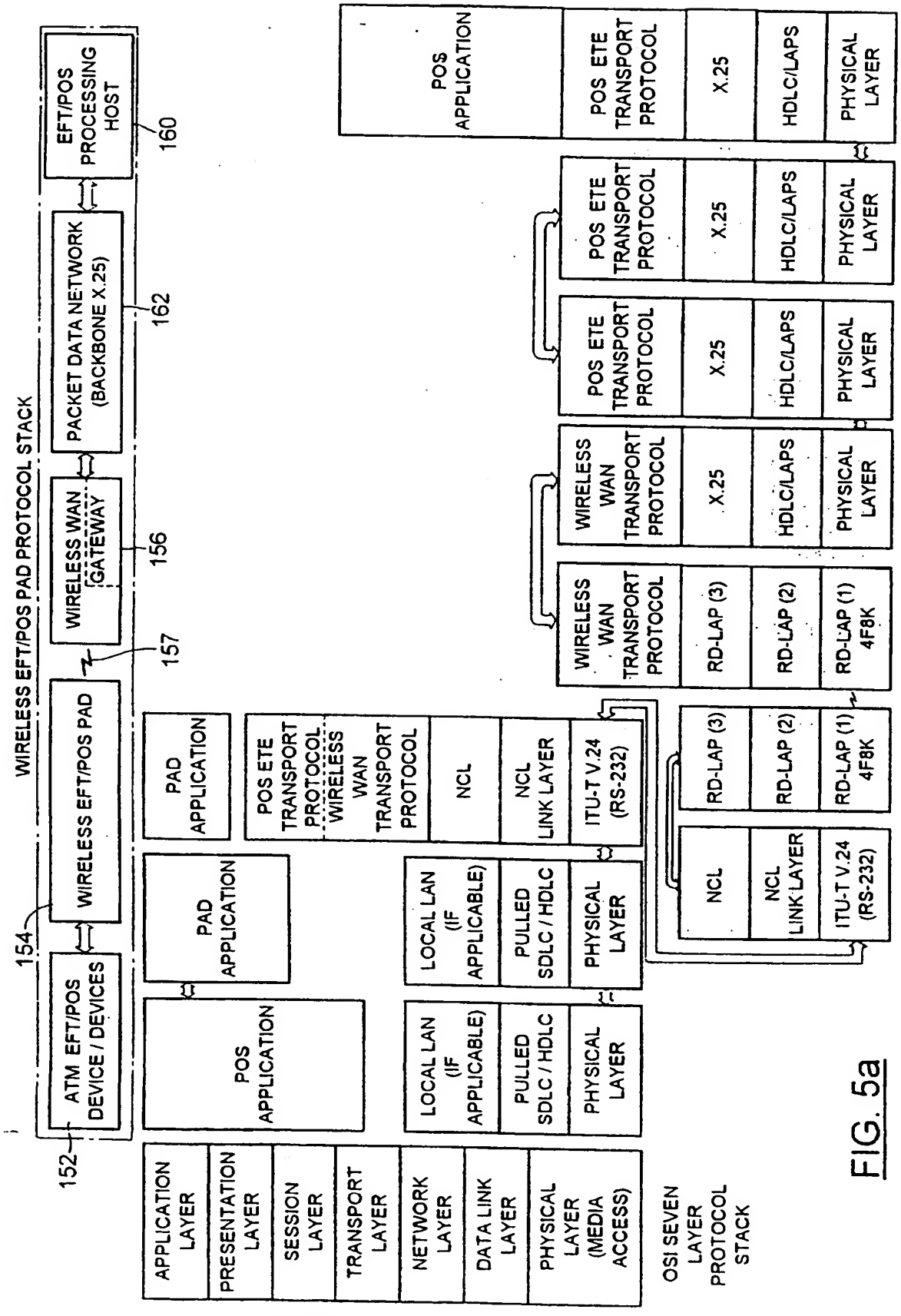

WIRELESS EFT/POS PAD PROTOCOL STACK
ATM EFT/POS DEVICE / DEVICES
WIRELESS EFT/POS PAD
WIRELESS WAN GATEWAY
PACKET DATA NETWORK (BACKBONE X.25)
EFT/POS PROCESSING HOST
152
154
156
157
160
162
PAD APPLICATION
POS APPLICATION
POS ETE TRANSPORT PROTOCOL
WIRELESS WAN TRANSPORT PROTOCOL
NCL
NCL LINK LAYER
ITU-T V.24 (RS-232)
LOCAL LAN (IF APPLICABLE)
PULLED SDLC / HDLC
PHYSICAL LAYER
RD-LAP (3)
RD-LAP (2)
RD-LAP (1) 4F8K
X.25
HDLC/LAPS
APPLICATION LAYER
PRESENTATION LAYER
SESSION LAYER
TRANSPORT LAYER
NETWORK LAYER
DATA LINK LAYER
PHYSICAL LAYER (MEDIA ACCESS)
OSI SEVEN LAYER PROTOCOL STACK

FIG. 5a

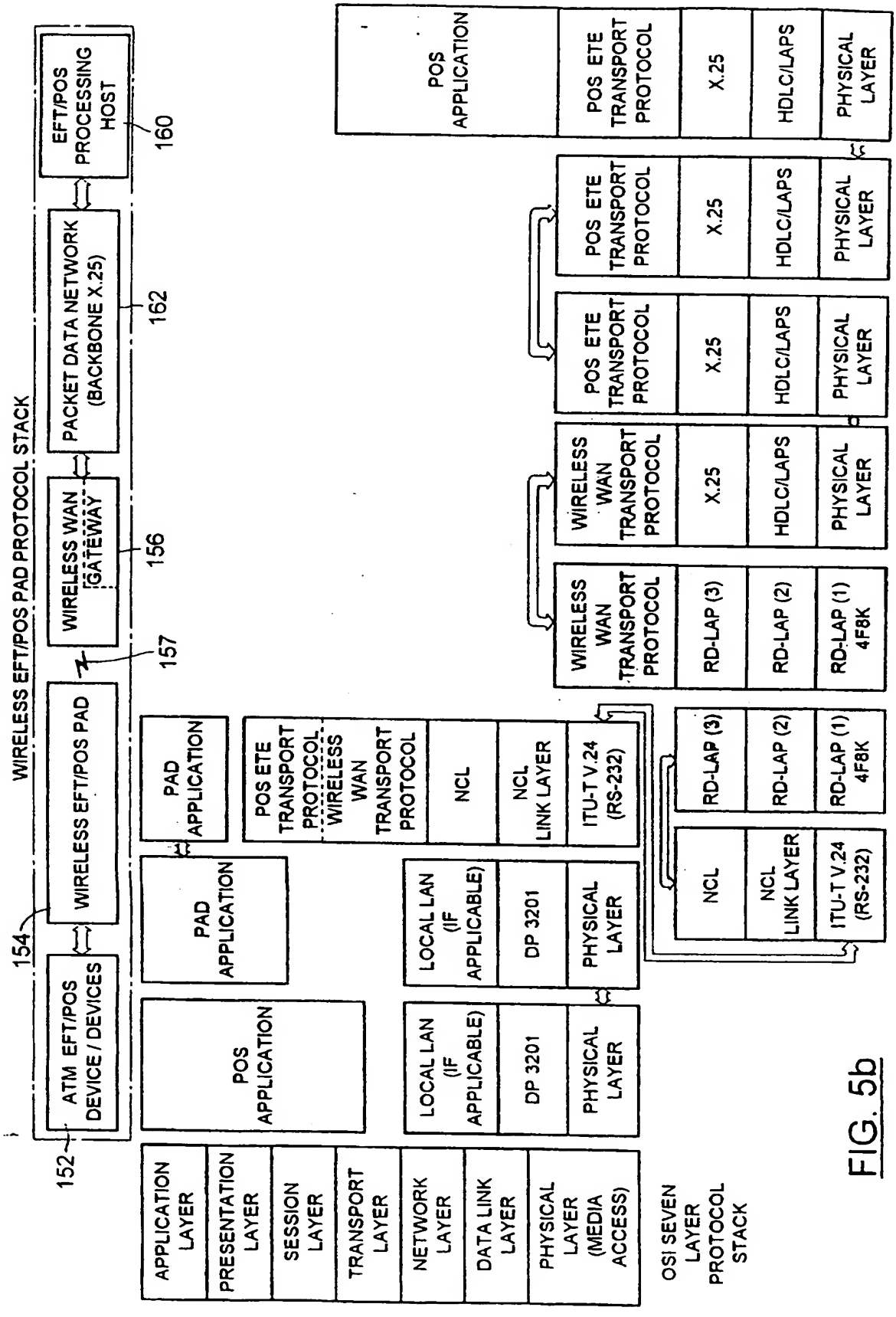
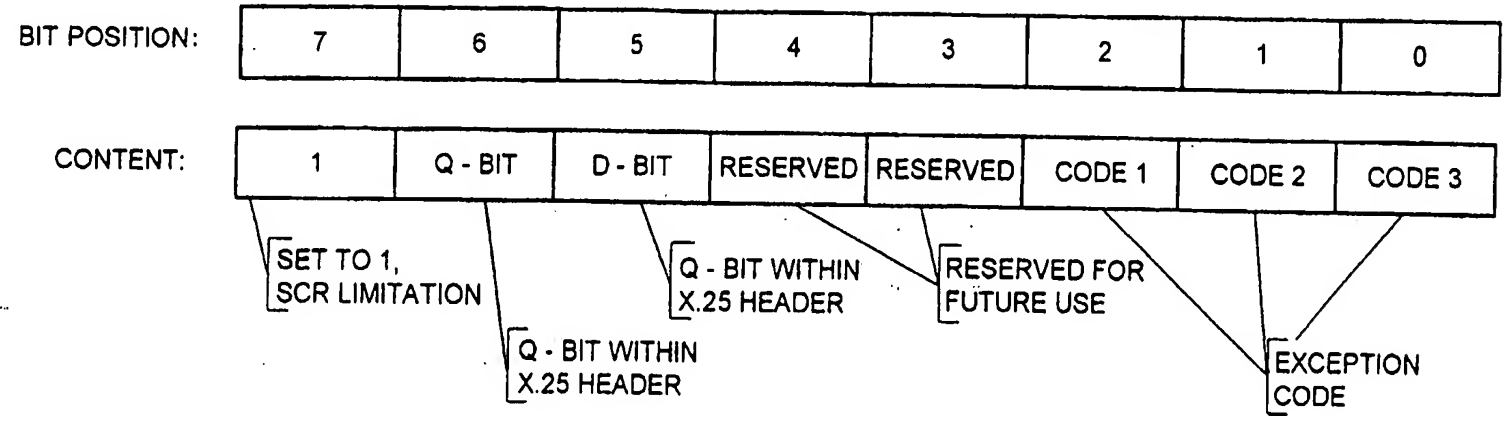

WIRELESS EFT/POS PAD PROTOCOL STACK
152
154
156
157
160
162
ATM EFT/POS DEVICE / DEVICES
WIRELESS EFT/POS PAD
WIRELESS WAN "GATEWAY"
PACKET DATA NETWORK (BACKBONE X.25)
EFT/POS PROCESSING HOST
POS APPLICATION
PAD APPLICATION
POS ETE TRANSPORT PROTOCOL
WIRELESS WAN TRANSPORT PROTOCOL
NCL
NCL LINK LAYER
ITU-T V.24 (RS-232)
LOCAL LAN (IF APPLICABLE)
DP 3201
PHYSICAL LAYER
RD-LAP (3)
RD-LAP (2)
RD-LAP (1) 4F8K
X.25
HDLC/LAPS
PHYSICAL LAYER
APPLICATION LAYER
PRESENTATION LAYER
SESSION LAYER
TRANSPORT LAYER
NETWORK LAYER
DATA LINK LAYER
PHYSICAL LAYER (MEDIA ACCESS)
OSI SEVEN LAYER PROTOCOL STACK

FIG. 5b

WIRELESS WAN TRANSPORT PROTOCOL

WIRELESS WAN TRANSPORT PROTOCOL HEADER - EXCEPTION BYTE



EXCEPTION CODES:

000 NULL (DATA OR POS ETE CONTROL MSG.)

001 X.25 CALL REQUEST

010 X.25 CALL ACCEPTED

011 NAK (WIRELESS WAN TRANSPORT PROTOCOL NOT ACKNOWLEDGE INDICATION, FOLLOWED BY ONE BYTE REASON CODE)

100 X.25 CLEAR REQUEST

101 X.25 CLEAR CONFIRM

110 X.25 RESET CONFIRM

111 ACK (WIRELESS WAN TRANSPORT PROTOCOL ACKNOWLEDGE INDICATION)

FIG. 6

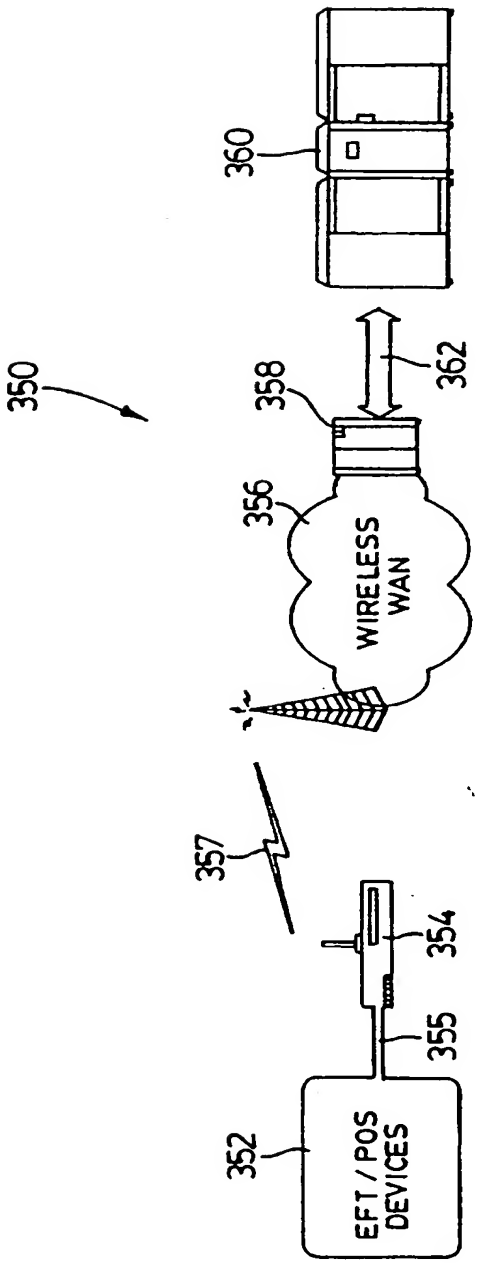

350
360
362
358
356
WIRELESS WAN
357
354
355
352
EFT / POS DEVICES

FIG. 7